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The Sociocultural Value of Upland Regions in the Vicinity of Cities in Comparison With Urban Green Spaces

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Mountain and upland regions provide a wide range of ecosystem services to residents and visitors. While ecosystem research in mountain regions is on the rise, the linkages between sociocultural benefits and ecological systems remain little explored. Mountainous regions close to urban areas provide numerous benefits to a large number of individuals, suggesting a high social value, particularly for cultural ecosystem services. We explored and compared visitors' valuation of ecosystem services in the Pentland Hills, an upland range close to the city of Edinburgh, Scotland, and urban green spaces within Edinburgh. Based on 715 responses to user surveys in both study areas, we identified intense use and high social value for both areas. Several ecosystem services were perceived as equally important in both areas, including many cultural ecosystem services. Significant differences were revealed in the value of physically using nature, which Pentland Hills users rated more highly than those in the urban green spaces, and of mitigation of pollutants and carbon sequestration, for which the urban green spaces were valued more highly. Major differences were further identified for preferences in future land management, with nature-oriented management preferred by about 57% of the interviewees in the Pentland Hills, compared to 31% in the urban parks. The study highlights the substantial value of upland areas in close vicinity to a city for physically using and experiencing nature, with a strong acceptance of nature conservation.

Keywords: *Ecosystem services; mountains near cities; urban green spaces; social valuation; perception; preferences in land management; Scotland.*

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Introduction

The concept of ecosystem services is well suited to assessing the contributions that ecosystems make to human well-being (Haines-Young and Potschin 2013) and to informing decision making in ecosystem management (MA 2003; Fisher et al 2009). The recently developed Common International Classification Scheme of Ecosystem Services (CICES) established 3 principal categories of ecosystem services: provisioning, regulating and maintenance, and cultural (Haines-Young and Potschin 2013). "Regulating services" include climate regulation through carbon sequestration, water purification, and flood regulation (Grêt-Regamey et al 2012); "provisioning services" include the provision of fresh water, raw materials, and food (Reed et al 2009, 2013; Briner et al 2013); and "cultural services" include inspiration, a sense of place, cultural heritage, recreation, and experiencing nature (Bagstad et al 2016; Zoderer et al 2016).

Mountains and upland regions provide a wide range of ecosystem services to residents and visitors (Grêt-Regamey et al 2012). Particularly in the vicinity of growing urban centers in and near mountain regions (eg as documented for the European Alps in Perlik et al 2001), these areas have the potential to supply ecosystem services to a large number of beneficiaries.

Ecosystem services have become an urgent policy interest, in particular because the European Commission explicitly included them in the 2050 vision and 2020 target of its Biodiversity Policy (European Commission 2011). As a result, European countries are now including them in their policies (The Scottish Government 2013). Aside from policy implications, the relative importance of different management options to facilitate the sustainable use of natural resources has been identified as a critical knowledge gap (Future Earth 2014; Box 1).

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BOX 1: Future Earth research priority

THEME: Transformations towards sustainability

C1: Understanding and evaluating transformations

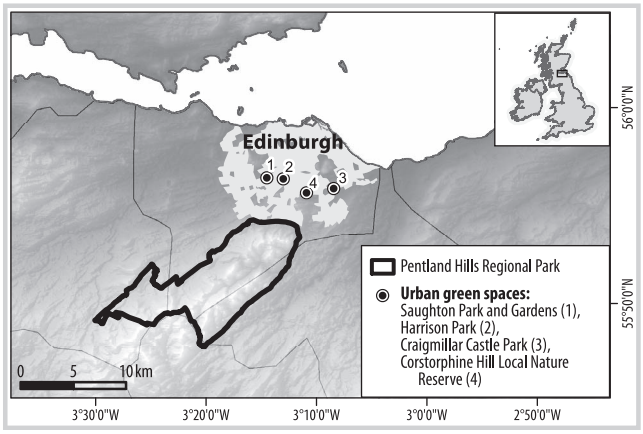
5. How should society prioritize the management of natural resources: (a) conservation, (b) restoration of systems where resources have been degraded or exhausted, or (c) improving the design and efficiency of systems to maximize benefits or reduce impact? What is the relative importance of these management approaches at different scales and in different contexts for the transition towards sustainable use of natural resources?

(Source: Future Earth Strategic Research Agenda 2014: C1.5)

Although ecosystem services are subject to multiple values, the assessment of monetary values often prevails mostly for regulating ecosystem services, jeopardizing the acknowledgement of less tangible social values as well as cultural ecosystem services (Nieto-Romero et al 2014; Sherrouse et al 2014). Nonmonetary sociocultural valuation of ecosystem services has proven to be a powerful technique to reveal perceptions of and provide differentiated information on the appreciation of ecosystem services, including in mountain areas (Walz et al 2016). Although not strictly providing a better understanding of the ecosystems, the particular potential of sociocultural valuation has been shown to elaborate more socially feasible ecosystem-management solutions for all ecosystems, including for mountain areas (Bagstad et al 2016).

In the vicinity of the urban agglomerations, extensively used rural upland areas are important, but they are not the sole source of ecosystem services. Other such sources include urban green spaces. These are usually highly appreciated by urban dwellers, with recreation being one of the highest-valued services due to its direct impact on physical health and mental well-being (Tzoulas et al 2007; Bertram and Rehdanz 2015). After this, regulating services are often recognized as important, especially the mediation of pollutants, again reflecting the importance urban residents place on health (Lo and Jim 2010; Martin-López et al 2012; Bertram and Rehdanz 2015). Several other cultural ecosystem services are also perceived as highly valuable in urban green spaces, including cultural history and identity, tourism, aesthetics, environmental education, the satisfaction of protecting biodiversity, and a sense of inspiration and peace (Lo and Jim 2010; Martin-López et al 2012; Oteros-Rozas et al 2014). In contrast, the provisioning and supporting services of urban green spaces are not deemed as important (Bertram and Rehdanz 2015).

FIGURE 1 Location of the study areas in Edinburgh and in the rural uplands. (Map by Eike Julius)



While ecosystem services are receiving increasing scientific attention (Haase et al 2014), we found no studies that explored the role of ecosystem services from extensively used upland areas in the vicinity of urban agglomerations, which serve additional purposes, including provisioning services such as farming and water provision.

In this study, we aimed to better understand the overlap or complementarity of such upland areas for visitors and to identify feasible management options. To that end, we compared use characteristics, the results of nonmonetary sociocultural valuation of ecosystem services, and visitors' preferences regarding land management options for the Pentland Hills, an upland area just south of Edinburgh, Scotland, and 4 of Edinburgh's inner-city green spaces. Specifically, we addressed the following 3 research questions:

1. How do visitors to the 2 study areas differ regarding frequency of visits, types of activities undertaken, and companions who accompanied them to the area?
2. What are the differences in their sociocultural valuation of ecosystem services?
3. How do their land management preferences differ?

Study areas

Pentland Hills

The Pentland Hills (55°50′55.7″ N; 3°18′27.8″ W) are located to the southwest of Edinburgh in the council areas of West Lothian and Midlothian (Figure 1); the northern part was designated a regional park in 1986. The park covers about 10,000 hectares and consists of a landscape of hills, extensive farmland and sheep grazing, upland heather moorland, small pockets of woodland, and reservoirs. The Pentland Hills provide an important recreational asset for the city and are frequently used for walking, running, and mountain biking, but also for more traditional activities such as hunting and fishing. Among

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other purposes, the regional park serves to encourage public enjoyment of the hills, and to coordinate between recreational use and other uses such as traditional sheep farming and woodland development for conservation.

Edinburgh urban green spaces

In Edinburgh, there are about 1500 hectares of green space managed by the City of Edinburgh Council, including 147 public parks with different features and facilities. Four parks were selected for this study, representing a variety of sizes and social settings, from socially deprived to wealthy residential areas (Figure 1):

- Saughton Park and Gardens (55°56′04.9″ N; 3°14′58.5″ W), in the Gorgie area, is 2.8 hectares in size and contains rose gardens, a walled garden and greenhouse, toilets, a car park, football and playing fields, a skateboard park, community woodlands, and seating, and it is bounded on the south and east by the Water of Leith, providing a water feature.
- Harrison Park (55°56′03.8″ N; 3°13′32.4″ W), in the Merchiston area, is 7 hectares in size and contains a formal garden featuring rose beds, a dog-free area, a community herb garden and beehive, football pitches, 2 play areas, and a cycle path. The Union Canal, providing a water feature, borders it along the southeast side.
- Craigmillar Castle Park (55°55′38.3″ N; 3°08′49.1″ W) is located on the southeast urban fringe. It is 65 hectares in size and contains woodlands and open grassland. It surrounds a large late-medieval castle and 16th century castle gardens, which form a popular tourist attraction, and it is bordered by several main roads.
- Corstorphine Hill (55°57′25.1″ N; 3°16′30.8″ W) is a park in the Corstorphine area. It is 56 hectares in size and contains the largest wooded area in Edinburgh as well as some open grassland.

Methods

Data collection

For this analysis, we combined the results of 2 structured surveys; these were designed to collect quantitative data through face-to-face interviews and an online survey. The surveys, conducted in the Pentland Hills and the selected urban green spaces, investigated participants' use patterns, valuation of ecosystem services, and preferences for land management, in upland and urban contexts. The questionnaires were completed using tablet computers; results were automatically entered into a spreadsheet to limit the risk of error from manual collation. A simple random sample method was used, in which the first person encountered was approached by one of our interviewers for a 10-minute interview. At the end of each interview, the next person encountered was approached (Özgüner 2011). In the case of the Pentland Hills, we used additional data from an online survey that was set up during the same time as the face-to-face interviews took place.

For the Pentland Hills, 563 questionnaires were completed in 2014 (454 face-to-face interviews, 109 online), and for the 4 urban parks, 152 people were surveyed in 2015 (38 at each park). The Pentland Hills sample contained 53% males and 47% females; participants in the urban parks were 60% female and 40% male.

The surveys included 6 questions; 5 of them were identical for both areas in wording and scale format. The last question had to be adjusted due to time and budget constraints in the urban case study: We asked respondents to choose between 4 predefined management scenarios visualized by photographs instead of compiling preferred landscape management options (*Supplemental material*, Table S1, http://dx.doi.org/10.1659/MRD-JOURNAL-D-16-00044.S1). Participants of the survey were asked about the frequency of their visits and the activities they took part in, which helped to form an idea of their relationship with green space. Participants were asked who accompanied them; answer options included a dog and various family and social groups. This was included to reflect whether the visit served a particular purpose or was made for a social reason, along with the nature of the social incentive.

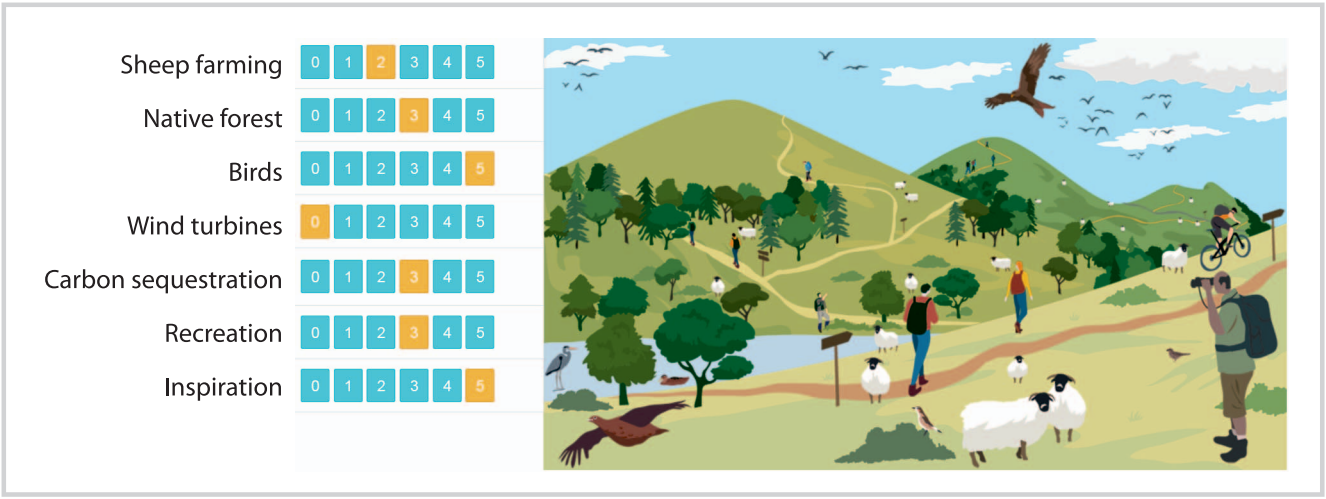
Participants were asked to value 8 park benefits in terms of importance to them personally (as opposed to how important they believed them to be for society). The benefits were based on the Common International Classification Scheme of Ecosystem Services (known as CICES; Haines-Young and Potschin 2013). This took place in 2 exercises: rating each benefit on a scale of 1 to 5, and allocating 100 points across all benefits. These are referred to hereafter as rating and weighting exercises, respectively. The weighting technique was based on a similar study on forest values by Brown and Reed (2000).

Landscape management preferences were determined differently in the 2 study areas. In the Pentland Hills, we asked participants to adjust a virtual landscape to show their preferences for actual and potential land uses (Figure 2). Prompted adjustable land uses were sheep farming (representing food provisioning), native forest (representing habitat for wild plants and trees), birds (representing habitat for wild animals), wind turbines (representing wind farming), carbon sequestration (representing climate regulation), and recreation. Combinations were restricted, so that participants had to decide on trade-offs between different land uses. Participants were then asked to indicate the level of inspiration this landscape could potentially provide for them on a scale from 0–5.

In the urban green spaces, we asked participants to distribute 100 points between 4 broad land management objectives: renaturalization (converting an area to be less managed and more natural), recreation, gardening, and inspiration and relaxation (Figure 3). Two of these

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FIGURE 2 Virtual landscape used to assess land management preferences among visitors to the Pentland Hills.

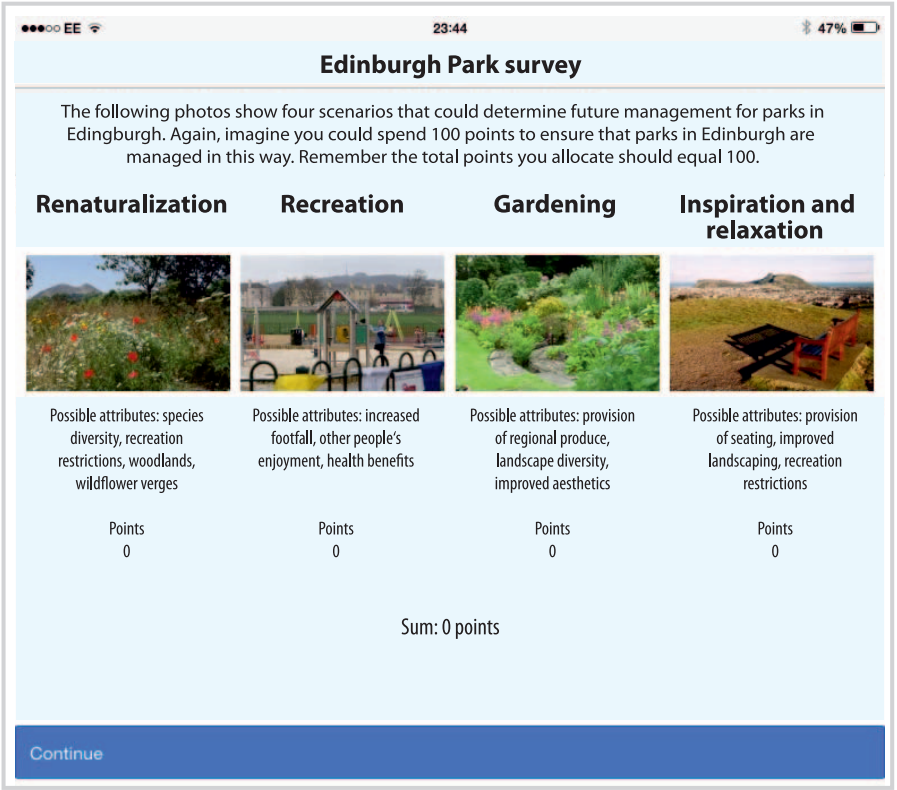


objectives were based on objectives of the Edinburgh Living Landscape project (Keegan 2014): to renaturalize 15% of all city parks, and to provide more food-growing areas in the city. The other 2 represented additional popular objectives for city park management (Özgüner 2011; Bertram and Rehdanz 2015).

Data analysis

The analysis focused on differences between the 2 study areas in use, valuation of ecosystem services, and land management preferences. Descriptive statistics were used to examine frequency of visits, activities undertaken, and presence of companions during visits to the study areas.

FIGURE 3 Landscape management illustration used to assess landscape management preferences among visitors to the urban green spaces. (Tablet screenshot)



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TABLE 1 Visitor use patterns.

Variable	Response	Percent of users	
		Pentland Hills	Urban green spaces
Frequency of visits	Once a day to several times a week	18	55
	Once a week to once a month	41	21
	Less than once a month	24	23
Activities	Walking	86	93
	Running	16	9
	Mountain biking	15	5
	Bird watching	11	16
	Photography	13	14
	Picnicking	15	22
	Nature observation	20	33
	Working	3	5
Company	Alone	22	7
	With a dog	21	56
	With a spouse	30	11
	With children	10	19
	With friends	29	17
	In a group	7	0
	With family	4	14
	With colleagues	1	1

Descriptive statistics were also used to examine the value of the ecosystem services. For each benefit, the mean value of importance and standard deviation were compared, as were the points allocated to each benefit by survey participants.

Significant differences between the study areas in ecosystem services ratings were tested for using the Wilcoxon test (Wilcoxon et al 1970). Land management preferences in the Pentland Hills were deduced from land-use scenarios as shown in the virtual landscape by using hierarchical cluster analysis.

Results

Age and residence

The majority of the interviewed visitors were local residents. Of those interviewed in the urban green spaces, 93% were Edinburgh residents; the remainder were tourists from Scotland (7), England (1), or overseas (2). In the Pentland Hills, 75% of the interviewed visitors were residents of Edinburgh, 13% were from the counties of West Lothian and Midlothian, and 9% were from other nearby counties (East Lothian, Berwickshire, Lanarkshire, and Fife), with travel distances up to about 1 hour. Only 3% came from more distant regions of Scotland, England, or Ireland.

The 2 samples differed in age structure. In the urban green spaces, 73% of interviewees were between 25 and 54, and only a few were older. In the Pentland Hills, all age groups over 25 were similarly represented, including those over 55.

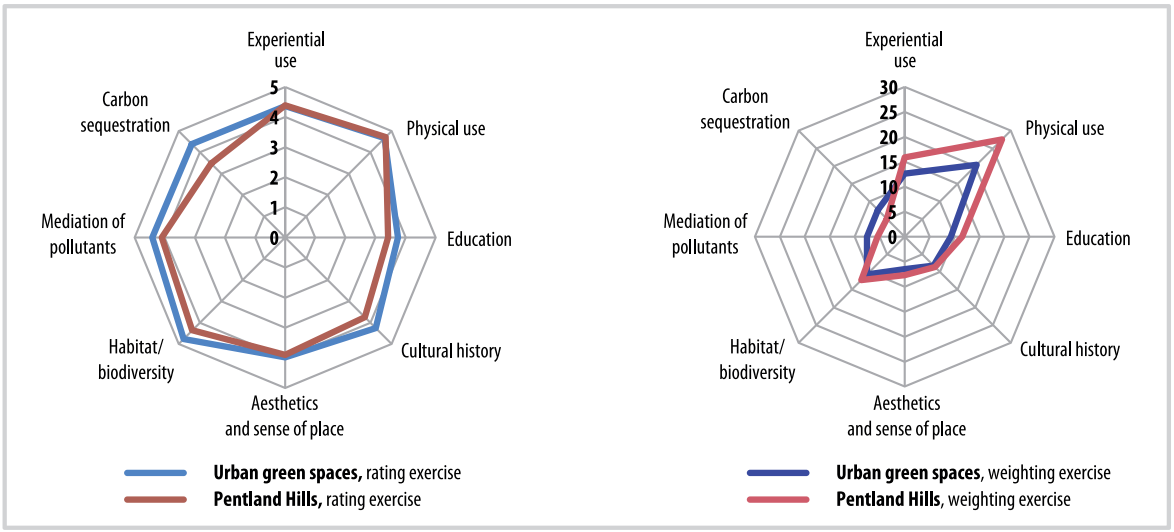
Use patterns

Most interviewees said they visited the area frequently. About 59% of the Pentland Hills respondents said they visited at least once a month, and 18% at least once a week. For the urban green spaces, 55% said they visited at least once a week, and another 21% at least once a month.

While the main activity in the urban green spaces was walking, survey participants in the Pentland Hills indicated a preference for a broad range of recreational activities, which included walking (also hill-walking), as

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FIGURE 4 Survey participants' assessments of ecosystem benefits: (A) mean values of personal rating; (B) mean amount of points allocated in weighting exercise.



well as running and mountain biking (Table 1). Despite the urban context, a higher percentage of participants in the urban green spaces indicated an interest in bird watching and nature observations than in the Pentland Hills. More than half of the participants in the urban green spaces were accompanied by a dog, as opposed to 21% in the Pentland Hills.

Value of ecosystem services

Cultural ecosystem services included in this survey were the experiential and physical use of nature, education, cultural history, and aesthetics or sense of place (for definitions, see *Supplemental material*, Table S1, http://dx.doi.org/10.1659/MRD-JOURNAL-D-16-00044.S1). Regulating and maintaining services included mediation of pollutants, carbon storage, and habitat and biodiversity.

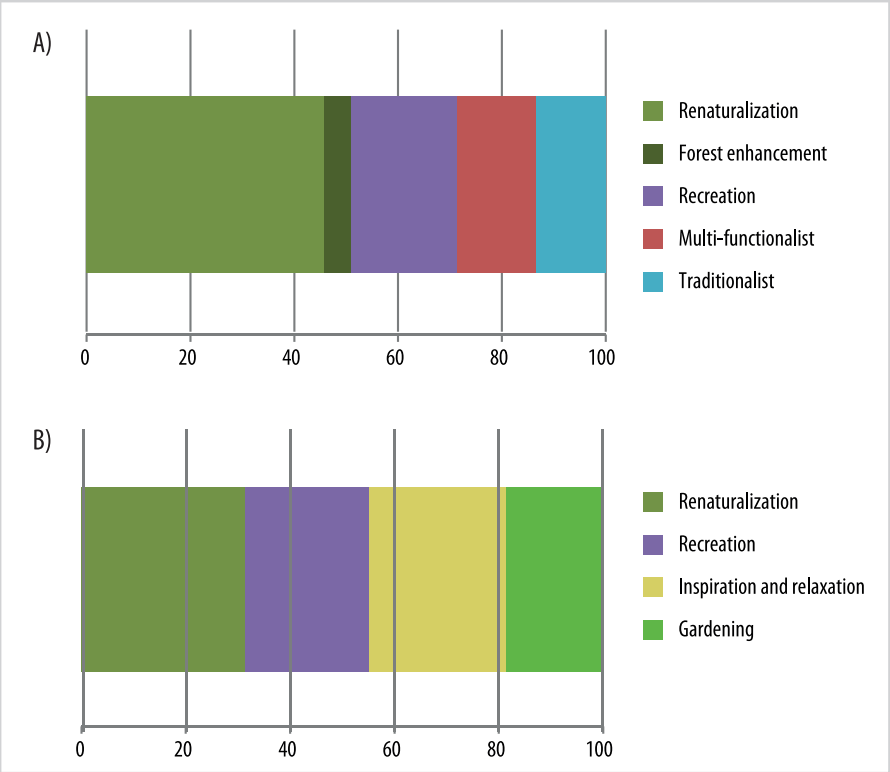
Participants in both areas gave all benefits high ratings (Figure 4A). Mean values in the Pentland Hills ranged between 3 and 5, and mean values in the urban green spaces ranged between 4 and 5. Education was rated rather low in both areas. In the Pentland Hills, carbon sequestration and cultural history also received rather low ratings. The Wilcoxon test revealed that the mean values of experiencing nature, physically using nature, and aesthetics/sense of place did not differ significantly between the upland and urban ecosystems (Table 2).

TABLE 2 Results of rating and weighting ecosystem services in the Pentland Hills and urban green spaces and Wilcoxon test results. Coefficients in bold font were significant with $p < 0.05$.

	Rating (scale of 1 to 5)					Weighting (points out of 100)				
	Pentland Hills		Urban green spaces		Wilcoxon test	Pentland Hills		Urban green spaces		Wilcoxon test
Ecosystem service	Mean value	Standard deviation	Mean value	Standard deviation	*p*-value	Mean value	Standard deviation	Mean value	Standard deviation	*p*-value
Experiencing nature	4.4	1.2	4.4	1.0	0.3	16	16	13	15	0.1
Physical use of nature	4.7	0.8	4.7	0.7	0.3	28	21	20	17	**0.0001**
Education	3.4	1.4	3.7	1.3	**0.003**	11	12	9	11	0.2
Cultural heritage	3.7	1.4	4.3	1.0	**3.4e−08**	9	12	8	8	0.1
Aesthetics/sense of place	3.9	1.3	4.0	1.2	0.3	8	10	6	6	0.6
Mediation of pollutants	4.1	1.4	4.4	1.0	**6.3e−06**	5	8	8	11	**0.002**
Carbon sequestration	3.5	1.7	4.4	1.0	**<2.2e−16**	5	5	8	9	**2.4e−05**
Habitat/biodiversity	**4.4**	1.2	4.8	0.5	**6.3e−09**	12	13	11	11	0.6

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FIGURE 5 Landscape management preferences among visitors interviewed: (A) in the Pentland Hills: percentage of respondents with similar management preferences; (B) in the urban green spaces: mean points allocated towards management scenarios.



The weighting exercise, which asked participants to distribute 100 points across all benefits, revealed more distinct preferences. Cultural ecosystem services, such as the physical use and experience of nature, were given the most points in both study areas (Figure 4B). The Wilcoxon test showed that the distribution of points was significantly different in the 2 study areas for the physical use of nature, mediation of pollutants, and carbon sequestration. While the physical use of nature received more mean points in the Pentland Hills, mediation of pollutants and carbon sequestration received more mean points in the urban green spaces.

Preferred landscape management options

In the Pentland Hills, responses to the question on management options revealed 5 preference clusters that were unequal in size (Figure 5A). Over half of the participants opted for a nature-oriented option, with 48% choosing enhancement of biodiversity (renaturalization) and 9% choosing woodland enhancement. Smaller groups preferred the status quo (traditionalist, 13%), recreation (15%), and a multifunctional landscape serving a variety of purposes such as habitat for wildlife and plants, sheep farming, and wind farming in almost equal parts (16%).

In the urban green spaces, the responses to the question on management options revealed strong preferences for a leisure-targeted management (Figure 5B), as implied by the scenarios including inspiration and relaxation (26 mean points) and recreation (24 mean points). Renaturalization received 31 mean points, and gardening received 19 mean points.

Discussion

Use, perception, and preferred management options

This study revealed that ecosystem services are of great importance to visitors to the uplands and the urban parks. Cultural ecosystem services, such as physical and experiential use of nature, as well as habitat and biodiversity, were valued the highest. Though our data show slight variations in the importance of different benefits, they suggest a strong overlap in the social perception and use of ecosystem services in both areas.

The high proportion of frequent visitors in both areas indicates their high use value and the important role they play in people's lives. In earlier studies, this has been explained by the opportunity to temporarily escape the urban context for urban green spaces (Bishop et al 2001). This reason could be an even stronger motivation for visits to the extensively used rural areas outside city limits.

Although physical exercise was an important motivation for visiting both areas, physical activities were often combined with nature observation, bird watching, photography, or similar directly nature-related activities.

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Surprisingly, nature-based activities were more frequently mentioned by visitors to the urban green spaces than by Pentland Hills visitors, and habitat for wildlife had a higher mean value in the urban green spaces. This shows that the limited green refuges are important to urban dwellers because of their ability to support at least limited wildlife in the city (Dennis and James 2016). This finding provides support for recent activities to enhance inner-city biodiversity in Edinburgh, for instance, by the Living Landscape project (Keegan 2014).

When it comes to preferences for future land management, however, support for restoration of more natural ecosystems and conservation measures was considerably higher in the Pentland Hills (48%) than in the urban green spaces (31%). Our findings thus suggest that although urban green spaces allow bird watching and other nature-based amenities, they mostly still serve cultural purposes. Open landscapes such as the Pentland Hills on the other hand can generate preferences for a more extensive, conservation-oriented form of landscape management. This could be due to the larger size of the area, in which conservation measures such as reforestation have a relatively small impact on the recreational potential of the entire park.

Methodological insights and limitations

A comparison of the results of the 2 surveys provides insights into the informative value of nonmonetary sociocultural valuation. The valuation of ecosystem services by rating (assigning Likert-scale values to each service) showed no strong differences between the two study samples: All ecosystem services received fairly high mean values (between 3.4 and 4.8). On the other hand, the weighting (allocating 100 points among all 8 services) of physical use of nature and experiencing nature was far more pronounced than in the rating exercise. Preferences towards the experiential and physical use of the respective landscapes could thus only clearly be assessed by the weighting exercise.

The informative value of the valuation results is further revealed by the number of ecosystem services that showed similar results for rating and weighting in the Wilcoxon test across both samples. For experiencing nature, the 2 valuation techniques indicated no significant difference, and for mediation of pollutants and carbon sequestration, both techniques indicated a significantly higher appreciation in the urban green spaces. Surprisingly, the weighting exercise (100-point allocation) did not give a more differentiated picture here. Significant differences between the 2 study areas were also revealed by the rating exercise (rating on a 5-point scale) for several ecosystem services.

In a more general sense, these insights highlight the methodological uncertainties in sociocultural valuation and indicate how difficult it is to compare areas and surveys. Although the 2 surveys were conducted in close collaboration, there were limitations. One well-documented limitation is related to the interview situations, where different persons conducting the survey as well as the location of the interview can convey a difference in the relevance of the questions and answers (Suchman and Jordan 1990). Furthermore, we assume there would be added insight about the motivations to visit and preferences for management in the study areas by including the comparison between the Pentland Hills and the urban green spaces directly within the questionnaire.

Transferability

Survey participants in both areas considered cultural ecosystem services particularly important. In line with Hein et al (2006), recreation, including both physical use and experience of nature, was most relevant. This confirms earlier results on the importance of access to green space for physical health (Dinnie et al 2013) and psychological well-being (Chiesura 2004; Ward Thompson 2013). These recreational benefits have been recognized universally for urban green spaces (Özgüner 2011) but have rarely been compared to nearby landscapes outside city limits. Moreover, to our knowledge no comparison between studies that assess values of cultural, provisioning, and regulating ecosystem services in urban ecosystems and ecosystems outside of cities has been published to date.

Interviewees in the 2 areas differed in their land management preferences. The enhancement of recreational opportunities was favored by a majority of interviewees in the urban green spaces and a minority in the upland area (Pentland Hills). Conversely, the preference for more natural ecosystems and conservation was more widespread in the upland area. The lack of similar comparative studies makes it impossible to confirm that this preference pattern also applies to similar rural upland areas settings in the vicinity of other cities.

Transferability of such knowledge between regions would in any case be limited. First, sociocultural values have been shown to vary considerably between even relatively similar regions (eg for three mountain regions in Austria and France; Haida et al 2016). Second, valuation of ecosystem services is increasingly moving into the domain of problem-oriented research, and in a specific management context, it usually incorporates process-oriented aspects (Liu et al 2010). This is inherent in the fact that individuals are directly invited to express their personal perception, and it can be considered one of the strong advantages of sociocultural valuation. Independent of the methods used, sociocultural valuation therefore has elements of consultation and participatory engagement in it (Chan et al 2012). It is therefore usually not adequate to transfer results or experience from other areas on to one in a concrete management context.

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Implications for sustainable development and policy recommendations

In line with the current literature (Egoh et al 2007; USEPA 2009), we strongly support including sociocultural valuation in assessments of ecosystem services to promote socially acceptable ways to restore natural ecosystems, enhance conservation, decrease the pressure on ecosystems, and ultimately support sustainable ecosystem management.

The consideration of ecosystem services in policy also ensures their relevance to society by explicitly incorporating human well-being (Egoh et al 2007; USEPA 2009). This makes conservation efforts more amenable to stakeholders and increases the likelihood of support and longevity. Unavoidable conflicts, including between the preferences of different social groups, can be addressed clearly.

It is important to incorporate sociocultural valuation in ecosystem service assessments to discuss such conflicts openly and consider alternative solutions to reduce them. The visitor surveys that were the focus of this study were only the start of a more comprehensive process of elaborating long-term development goals for the Pentland Hills area. They were followed by interviews with stakeholders in the Pentland Hills, as well as formal workshops with landowners (mostly farmers) and representatives of various interest groups. Within the stakeholder workshop, participants were encouraged to voice concerns regarding park issues that they felt needed to be considered in the next management plan,

Conclusions

This study compared use patterns, values, and landscape management preferences of visitors to an upland hill range in the vicinity of Edinburgh and 4 urban green spaces in the city. The results revealed high sociocultural valuation of both ecosystems. Significant differences were revealed in the value of physical use of nature, which were valued more highly by visitors to the uplands, whereas mitigation of pollutants and carbon sequestration were valued more highly by visitors to the urban green spaces. Visitors to the 2 areas also prioritized land management options differently, favoring the enhancement of recreational opportunities in the parks and restoration of more natural ecosystems in the upland area.

The study highlights the substantial value of the upland area for urban dwellers, mainly for the physical use and experience of nature, and its high potential to enhance nature conservation. Knowledge of the value people place on different ecosystem services and their preferences for different landscape management approaches may contribute to more sustainable development of both ecosystems.

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Supplemental material

TABLE S1 Survey components.

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